Original Research Paper

Volume - 11 | Issue - 07 | July - 2021 | PRINT ISSN No. 2249 - 555X | DOI : 10.36106/ijar

Clinical Science

EFFICACY OF DIODE LASER AND VARIOUS CHEMICAL IRRIGANTS FOR ROOT CANAL DISINFECTION- A COMPARATIVE VIVO STUDY

Dr. Mohd. Sarfraj* Assistant Professor, Department of Paedodontics and Preventive Dentistry, Career Post Graduate Institute of Dental sciences & Hospital, Lucknow.*Corresponding Author

Dr. Monika Koul Professor & Head, Department Of Paedodontics And Preventive Dentistry, Vice Principal, Career Post Graduate Institute Of Dental Sciences & Hospital, Lucknow

Dr. Vinod Kumar Upadhyay Professor, Department Of Paedodontics And Preventive Dentistry, Career Post Graduate Institute Of Dental Sciences & Hospital, Lucknow

ABSTRACT **INTRODUCTION:** In endodontic treatment quite often clinician meets with the challenge to disinfect the root canal. Ahead of the obturation of root canal system, eradication of microorganisms from infected root canals is an intricate task as microorganisms spread in the pulpal and periapical area and also in the lateral dentinal tubules of the root which extensively reduces the treatment success. **AIM & OBJECTIVE:** To evaluate the efficacy of diode laser at pulse mode and three irrigants viz 5.25% sodium hypochlorite, 2% chlorhexidine and 0.5% metronidazole on total viable bacterial count in root canals of human permanent teeth indicated for root canal therapy by a microbiological assessment. **MATERIALS AND METHODS:** Forty-four permanent single-rooted teeth with closed apices indicated for root canal therapy were selected as a sample. Samples were randomly divided into four groups. Group A: 5.25% Sodium hypochlorite, Group B: 2% Chlorhexidine gluconate, Group C: 0.5%Metronidazole solution, Group D: Diode laser. The pre-op. and post-op. specimens of each tooth were inoculated on sheep blood agar and McConkey agar by pour plate method and examined for any aerobic /facultative anaerobic bacterial growth. **RESULT:** The pre- and post-total viable bacterial count of four groups decrease was found highest in Group A (99.4%) followed by Group D (97.1%), Group B (96.9%) and least in Group C (95.7%). **CONCLUSION:** Sodium hypochlorite, diode laser, chlorhexidine gluconate, and metronidazole all were significantly effective in reducing the bacterial count from root canals. The bacterial count was seen to be reduced highest in sodium hypochlorite group however it did not differ significantly among the groups (P >0.05).

KEYWORDS : Root Canal Disinfection, Irrigating Solution, Diode Laser, Agar Media, Endodontic Microflora.

INTRODUCTION

Disinfection of the root canal system has constantly remained a task for the clinician within the field of endodontics. Before the obturation of the root canal system, elimination of microorganisms from infected root canals may be a difficult task thanks to the spread of microorganisms within the pulpal and periapical area and also within the lateral dentinal tubules of the root which significantly reduces the treatment success. Characteristically the root canal disinfection is recognized through biomechanical preparation along with side the utilization of irrigants.[1] The irrigants assist the elimination of microorganisms, debris, tissue remnants, and dentin chips from the root canal through a flushing mechanism and disinfection of the root canal. As a perfect requirement of irrigant, it shouldn't irritate or damage vital periapical tissue and weaken the tooth structure, and will not have caustic or cytotoxic effects.[2] through the years; different irrigating solutions are recommended. a couple of those are the stream of predicament, physiologic saline, a 30% solution of urea, urea peroxide solution in glycerin, an answer of chloramines, hypochlorite, and hypochlorite in conjunction with ethylene di-amino tetra-acetic acid (EDTA), chlorhexidine gluconate, metronidazole solution. Irrigating solutions used during passage treatment act through direct contact with the bacteria targeted. Irrigants have inadequate penetration depth; as a consequence, these microorganisms within the deeper layers aren't demolished. Microorganisms are ready to invade the peri-luminal dentin up to a depth of 1100 micrometers, whereas the chemical irrigants penetrate less than 130 micrometers into the dentin.[3] Laser light can penetrate the world of the canal where rinsing solutions haven't any access like secondary canals and depth of dentinal tubules.[4] it's become the newest option to eradicate microorganisms within the root channel; especially within the lateral dentinal tubules. This light directly within the passage does have a bactericidal effect. [3] Lasers are claimed to disinfect the root canal system with significant consistency and efficiency.

Therefore, this study aimed to gauge and compare the efficacy of diode laser at pulse mode and three irrigants viz 5.25% hypochlorite, 2% chlorhexidine and 0.5% metronidazole on a total viable bacterial count in passage s of human permanent teeth indicated for root canal therapy by a microbiological assessment.

AIM & OBJECTIVE:

To evaluate the efficacy of diode laser at pulse mode and three irrigants viz 5.25% sodium hypochlorite, 2% chlorhexidine and 0.5% metronidazole on total viable bacterial count in root canals of human permanent teeth indicated for root canal therapy by a microbiological assessment.

MATERIALS AND METHOD:

This study was performed on patients below 18 years aged on permanent single-rooted teeth indicated for passage therapy within the Department of Paedodontics and Preventive Dentistry in Career Post Graduate Institute of Dental Sciences & Hospital, Lucknow. Written consent was taken before initiated the study. In our study, permanent single-rooted teeth with closed apices requiring passage therapy were considered. Forty-four samples were randomly divided into four groups. Group A: 5.25% Sodium hypochlorite, Group B: 2% Chlorhexidine gluconate, Group C: .5%Metronidazole solution and Group D: Diode laser. Each tooth of the corresponding group after gaining patency of the root canal, the first sample from the root canal was taken using a sterile absorbent point and transferred to a sterile tube containing normal saline medium. After biomechanical preparation, the root canal was disinfected and then the second sample was obtained using an absorbent point and transferred to a separate sterile tube containing normal saline medium. The preoperative and post-operative specimens of each tooth were inoculated on sheep blood agar and McConkey agar by pour plate method and examined for any aerobic /facultative anaerobic bacterial growth. The data obtained for each group was tabulated and analyzed statistically.

STATISTICAL ANALYSIS AND RESULTS:

The pre- and post-total viable bacterial count of four groups is summarized in Table 1 and also depicted in Graph 1. The mean total viable bacterial count decreased comparatively in all groups after the treatment and the decrease was found highest in Group A (99.4%) followed by Group D (97.1%), Group B (96.9%) and least in Group C (95.7%).

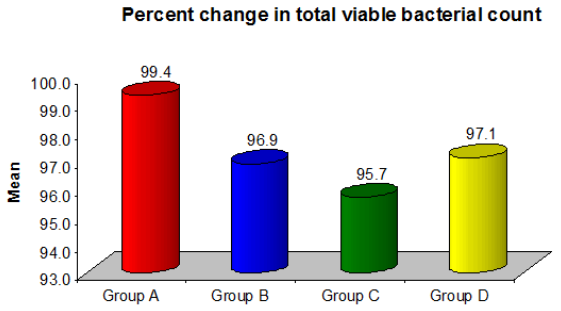
For each group, comparing the pre and post mean total viable bacterial count, Wilcoxon matched pairs test showed significant ($p<0.01$) decrease in total viable bacterial count of all groups: Group A (50.64 ± 6.58 vs. 0.33 ± 0.24, mean change=50.31 ± 6.57, Z=2.93, p=0.003), Group B (45.64 ± 7.13 vs. 1.41 ± 0.56, mean change=44.23 ± 6.72, Z=2.93, p=0.003), Group C (42.82 ± 3.68 vs. 1.84 ± 0.88, mean change=40.98 ± 3.77, Z=2.93, p=0.003), and Group D (47.00 ± 5.40 vs. 1.36 ± 0.62, mean change=45.64 ± 5.07, Z=2.93, p=0.003).

Further, comparing the pre to post mean decrease (i.e. mean change) in total viable bacterial count of four groups, Kruskal-Wallis ANOVA showed similar decrease (i.e. mean change) in total viable bacterial count among the groups [Kruskal-Wallis H (3, n=44) =2.50, p=0.474)].

Further, comparing the mean decrease in total viable bacterial count between the groups, Z test also showed similar (p>0.05) change/decrease in total viable bacterial count among the groups i.e., did not differ significantly.

Table 1: Pre and post total viable bacterial count (10^5 x CFU/ml) (Mean ± SE, n=11) of four groups

Group	Pre	Post	Mean change	Mean change(%)	Z value	P value
Group A	50.64 ± 6.58	0.33±0.24	50.31 ± 6.57	99.4	2.93	0.003
Group B	45.64 ± 7.13	1.41±0.56	44.23 ± 6.72	96.9	2.93	0.003
Group C	42.82 ± 3.68	1.84±0.88	40.98 ± 3.77	95.7	2.93	0.003
Group D	47.00 ± 5.40	1.36±0.62	45.64 ± 5.07	97.1	2.93	0.003



Graph.1. Pre to post percent mean decrease in total viable bacterial counts of four groups.

DISCUSSION:

The critical stage in canal disinfection is chemo-mechanical preparation of the root canal with a combination of mechanical instrumentation and antibacterial irrigation. However, no irrigants can abolish all organic and inorganic matter and at the same time transmit a substantive superfluous antibacterial property to the canal wall dentin.[1] In the current study the apical preparation in all the samples irrespective of the tooth type was done up to ISO, 45 K file. This is in parallel to study done by Khademi et al who determined that minimum instrumentation size is essential for the effectual penetration of irrigants and the eradication of debris and smear layer from the apical third of the root canal.[5] Several preparation techniques have been advocated for use in the preparation of the root canals ranging from the step back, crown down, modified step down, hybrid technique or the balance force concept. In this study, the step-back technique was used and the samples including the anterior teeth were correctly and effectively prepared. The present in vivo study evaluates the efficacy of diode laser in pulse mode and 5.25% sodium hypochlorite, 2% chlorhexidine gluconate, 0.5% metronidazole irrigants for root canal disinfection. The outcome measure of the study was total viable bacterial count assessed at pre- and post-treatment and measured in CFU/ml, the objective of which was to compare the antimicrobial efficacy of these disinfectants. As done previously Mashalker et al normal saline was used as a transport medium and the pour plate method was used in microbiological culture. Organisms in the normal saline do not multiply and the count remains the same in the samples. Pour plate method is technique for counting thenumber of colony-forming bacteria present during a liquid specimen. This method of counting bacteria is more precise than the streak plate method and does not require a previously prepared plate. Samples were inoculated on sheep blood agar. Sheep Blood agar is an enriched, bacterial growth medium for fastidious organisms, such as streptococci, hemolytic bacteria that do not grow well on ordinary growth media. Efficacy of different irrigating solutions can be explained based on the depth of penetration and effective removal of the smear layer. The disproportionate amount of penetration depth among micro-organisms and bactericidal rinsing solutions often holds accountable for therapy-resistant cases and long-term failures which can be seen in conventional endodontics.[6] Brutti E et al demonstrated that microorganisms are capable of invading the peri-luminal dentin up to a depth of 1100 micrometer whereas, the chemical irrigants penetrate no more than 130 micrometers into the dentin.[5]Newer treatment strategies should be considered to eliminate microbes from the root canal system which penetrate up to 1110 micrometer and laser light which penetrate up to >1000 micrometers into the dentin have scope for complete root canal sterilization.[7] In this study Diode laser was used set at the following parameters-WAVELENGTH- 980 nm, POWER: Average 1.25 W- Peak 2.50 W, MODE: Pulsed - 50% duty cycle – 50 Hz, TIME: 5 s / Canal, FIBRE: 300 µm. The device is versatile, compact, and easy to move and has less cast as compared to other lasers. One of the qualities of diode lasers that ensure a successful endodontic treatment is its antibacterial ability causing disinfection of root canal system. Sterile Saline solution was used as an irrigant for the laser group. Saline does not only enhanceantibacterial effect; it alsoprovides a means of a lubricating agent and helps to flush out debris during biomechanical preparation.[8] The diode laser device is composed of 2 layers of semiconductor material interlaced with a nonconductive layer (bandgap layer). In comparison to Nd: YAG laserthe diodeallows greater absorption by water than dental tissues. This characteristic means greater laser light penetration through the dentin with little interaction on the dentin, making it possible to act on the microorganisms present in the dentinal tubules.[9] The pre and post total viable bacterial count of four groups was showed that the mean total viable bacterial count decreased comparatively in all groups after the treatments and the decrease was found highest in 5.25% sodium hypochlorite (Group A 99.4%) followed by diode laser (Group D 97.1%), 2% chlorhexidine gluconate (Group B 96.9%) and 0.5% metronidazole solution (Group C (95.7%) the least. For each group, comparing the pre and post mean total viable bacterial count, Wilcoxon matched-pairs test showed significant (p<0.01) decrease in total viable bacterial count of all groups; Group A (50.64 ± 6.58 vs. 0.33 ± 0.24, mean change=50.31 ± 6.57, Z=2.93, p=0.003), Group B (45.64 ± 7.13 vs. 1.41 ± 0.56, mean change=44.23 ± 6.72, Z=2.93, p=0.003), Group C (42.82 ± 3.68 vs. 1.84 ± 0.88, mean change=40.98 ± 3.77, Z=2.93, p=0.003), and Group D (47.00 ± 5.40 vs. 1.36 ± 0.62, mean change=45.64 ± 5.07, Z=2.93, p=0.003). Further, comparing the pre to post mean decrease (i.e., mean change) in total viable bacterial count of four groups, Kruskal-Wallis ANOVA showed a similar decrease (i.e., mean change) in total viable bacterial count among the groups [Kruskal-Wallis H (3, n=44) =2.50, p=0.474)]. Further, comparing the mean decrease in total viable bacterial count between the groups, the Z test also showed similar (p>0.05) change/decrease in total viable bacterial count among the groups i.e., did not differ significantly.

Mashalkar et al. concluded from their in-vivo comparative study that conventional method of root canal disinfection using sodium hypochlorite and hydrogen peroxide as irrigating solutions were highly effective, however, diode laser when used can also reduce the bacterial load of the infected root canal.[8] Mathew et al showed that the application of either diode laser or NaOCl alone did not bring a considerable reduction in the bacterial colony. It is also observed that the synergic effect of diode laser photodynamic therapy (PDT) combined with NaOCl found to be very effective in eradicating Gram-positive, aerobic bacteria (Streptococcus group). Ayhan et al. establish that higher concentrations of NaOCl (4-5.25%) were more efficacious than 1-2% CHX in eradicating E. faecalis. Agrawal et al concluded that chemical disinfection with either 2% CHX or 5.25%NaOCl help achieve complete eradication of E.fecalis from the root canals, whereas diode LASER was partially effective.[1]Ashofteh K et al concluded that 5.25% sodium hypochlorite was the most effective agent followed by 2% Chlorhexidine than laser.[10] Mohit Gunwal and Pratima Shenoi indicated that 810nm diode laser reduces microbial count more significantly as compared to 5.25% NaOCl, 2% Chlorhexidine, and the mixture of tetracycline isomer, an acid, and detergent (MTAD) solution, whereas in solutions MTAD stands better than others. Vianna and Gomes observed the larger inhibition zones of 2% CHX either in the liquid or the gel form compared to that of 5.25% NaOCl. Within the scope of this, research it was found that disinfection of root canals using diode laser and chemical disinfection with 5.25% sodium hypochlorite, 2% chlorhexidine gluconate, and 0.5% metronidazole solution was efficacious and significantly reduced the bacterial loads. However, sodium hypochlorite was highly effective in disinfecting the root canals because of the highest number of decreases in bacterial count as compared to others. But none of the disinfectants used completely eradicated the bacteria from root canals. The patients who served as study samples did not report any allergic reaction to the disinfectants used for root canal therapy.

CONCLUSION:

Diode laser at pulse mode can effectively reduce the microbial loads from root canals and be used as an alternative to chemical disinfection

in routine root canal therapy. Further studies in this regard are indicated to ascertain its efficiency at different modes too. The efficacy of 5.25% sodium hypochlorite, diode laser, 2% chlorhexidine and 0.5% metronidazole reflect their previously proved physical and chemical properties. For a definitive conclusion, a larger sample size with clinical and in-vitro investigations with these disinfectants is suggestive for future study.

REFERENCES

1. Agrawal AA, Kolhe S, Sope A, Erlewad D. Root Canal Disinfection Potential of 5.25% Sodium Hypochlorite, 2% Chlorhexidine and 810nm Diode Laser-A Comparative In vitro Antimicrobial Study. Int J Oral Craniofac Sci,2016; 2(1): 035-038.
2. Asnaashari M, Safavi N. Disinfection of Contaminated Canals by Different Laser Wavelengths, while Performing Root Canal Therapy. J Lasers Med Sci 2013; 4(1):8-16.
3. Berutti E, Marini R, Angeretti A. Penetration ability of different irrigants into dentinal tubules. J Endod 1997;23(12):725–727
4. Cohen S, Burns RC. Pathways of Pulp. 7th ed. St. Luis Mosby; 1994:633e671.
5. Khademi A, Yazdizadah M, Faizianfard M. Determination of the minimum instrumentation size for penetration of irrigants to the apical third of root canal system. J. Endod.2006; 32 (5): 417-20.
6. Gunwal M, Shenoi P. Evaluation of the efficacy of 5.25% of sodium hypochlorite, 2% of chlorhexidine, mtad and 810 diode laser in reduction of microbial count in root canal - an in vivo study. Endodontol, 2013; 25: 56-62.
7. Mohammadi Z, Jafarzadeh H, Shalavi S, Palazzi F. Recent Advances in Root Canal Disinfection: A Review. *Iran Endod J*. 2017;12(4):402–406.
8. Mashalkar S, Pawar MG, Kolhe S, Jain DT. Comparative evaluation of root canal disinfection by conventional method and laser: an in vivo study. Niger J Clin Pract, 2014; 17: 67-74.
9. Kaiwar A, Usha HL, Meena N, Ashwini P, Murthy CS. The efficiency of root canal disinfection using a diode laser: *In vitro* study. Indian J Dent Res 2013; 24:14-8.
10. Ashofteh K, Sohrabi K, IranparvarK ,Chiniforush N, In vitro comparison of the antibacterial effect of three intracranial irrigants and diode laser on root canals infected with Enterococcus faecalis. Indian J Microbiol 2014; 6:26-30.